M.R P. 1020
S.C. 11/223
7th December, 1956

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Average height of the standard isobaric surfaces over the area from the North Pole to 55°N. in April and October

by

H. Heastie

(Meteorological Office)

AIR MINISTRY

METEOROLOGICAL RESEARCH COMMITTEE

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1. Introduction

This paper is a continuation of M.R.P.918(1) and M.R.P.981(2). In (1), the decision to start the revision of Geophysical Memoir 85 - Upper Winds over the World - by constructing circumpolar charts of the standard isobaric surfaces was explained and the present paper together with the two earlier papers completes this section of the revision.

2. The data

Data for the same fixed period 1949-53 were used and the sources are listed in the earlier papers.

3. Method of constructing the charts

(1) General. The method employed was the same as that used for the July charts. Again the data from Siberia were very sparse both in April and October, 1949 and the charts for these months were drawn up to the 300 mb level by means of the correlation method described in (2).

(2) Effect of solar radiation. It was not possible to use data from night time ascents only. 0300 G.M.T. data were used generally, but 1500 G.M.T. data were available from the Aleutian and Alaskan stations and were used when the 0300 G.M.T. ascents were made in daylight. At 0300 G.M.T., daylight covers most of the U.S.S.R. in April and all of Siberia in October, and no Russian data for 1500 G.M.T. were available. Guterman (3) discusses the radiation correction of the comb radiosonde used in the U.S.S.R. and suggests that for solar elevations below 15° the error is negligible. For solar elevations of 50-60° he quotes an error of 0.5°C at 10,000 metres and 1.9°C at 15,000 metres. Over that part of the U.S.S.R. north of 55°N., for the months of April and October, the solar elevation varies up to a maximum of 40°. An error of 0.5°C in the 300 mb temperature would lead to an error of 3-4 metres in the 500-300 mb thickness and this error has been ignored. Errors of 0.5°C and 1.9°C in the 300 mb and 100 mb temperatures respectively would produce an error of the order of 30-35 metres in the thickness between 300 and 100 mb. However, no Russian data above 300 mb were available and use was made of the temperature lapses from the memoir on upper air temperature (4). In the preparation of this memoir data at both 0300 and 1500 G.M.T. were used and, it is reasonable to suppose, any error due to radiation halved in consequence. Further, the maximum elevation of the sun for the area and period considered is 10° or more below that to which the radiation corrections quoted are applicable. It was assumed, therefore, that the maximum error due

/to

to radiation in the 300-100 mb thickness (and consequently in the 100 mb contours) was less than 20 metres. As, however, the variation of radiation correction with solar elevation was unknown, no attempt was made to assess the actual error.

4. The charts

The April charts show two interesting differences from those for the other mid-season months. The first concerns the centre of the main circulation. In January, July and October, at all levels above 700 mb, this centre lies between 75° and 90°W. and 67° and 87°N. In April it lies at 84°N., 50°E. at 700 mb and shifts to 84°N., 35°W. at 300 mb and to 82°N., 10°W. at 100 mb. It is possible to attribute the centre at 700 mb to the persistence of a secondary centre at about 80°N., 70°E. on the January 700 mb chart. Changes from a winter to a summer regime take place very rapidly in the spring and not necessarily at the same time in different regions of the chart (though detailed evidence from the Russian Arctic is lacking) and it is doubtful whether the April or any other monthly chart represents a true "mid-season" circulation pattern. The second peculiarity of the April charts is a departure from the normal association between features of the tropopause pressure and stratospheric thickness patterns shown generally on the charts for the other three months. This occurs at about 20°E. where the tropopause pressure chart (5) shows a marked ridge which is almost immediately below troughs in the three thickness charts 300-200 mb, 200-150 mb and 150-100 mb i.e., relatively low stratospheric temperatures above a relatively low tropopause. These thickness patterns are consistent with the patterns shown on the relevant average temperature charts (4).

An apparently similar peculiarity occurs on the October charts over the Aleutians where high stratospheric thickness is shown over high tropopause (5). The average temperature charts (4) agree with this thickness pattern. No data from the Aleutians were used in drawing the tropopause pressure chart and this chart could probably be redrawn largely to remove this peculiarity.

Both the April and October charts show a westerly circulation at all levels with main troughs at 60-80°W. and 160-180°W., though there appears to be a weak secondary circulation at 700 mb in the Bering Sea in October. The main centre of the circulation lies between Franz Josef Land and NE. Greenland in April and over Ellesmere Island in October. The April charts show a further main trough about 0°W. and a rather indeterminate trough over Siberia, while in October there are troughs between Iceland and Greenland and over western Siberia.

The stratospheric thickness charts in both months are extremely flat, the thermal winds being generally of the order of 3 kt or less. Relatively high values of thickness are shown over Siberia and northern Canada, corresponding to the two main centres of low tropopause (5).

References

(1) Heastie, H. Average height of the standard isobaric surfaces over the area from the North Pole to 55°N. in January. Meteorological Research Papers, Air Ministry, London, No.918, 1955.

(2) Heastie, H. Average height of the standard isobaric surfaces over the area from the North Pole to 55°N. in July. Meteorological Research Papers, Air Ministry, London, No. 981, 1956.

(3) Guterman, I.G. Radiation error of the comb radiosonde. Trans. by A.I. Trans. (Org.)(T) of: Leningrad, Met. Hydr., 1955, No.5, pp. 49-52. London, 1956.

(4) Goldie, N., Moore, J.G. and Austin, E.E. Upper air temperature over the world. Geophys. Mem. No.101, London (in the press).

(5) Moore, J.G. Average pressure and temperature of the tropopause. Meteorological Research Papers, Air Ministry, London, No.874, 1954.

M.R.P. 1020

AVERAGE 700 mb. CONTOURS

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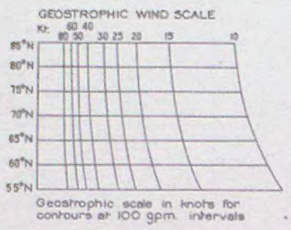
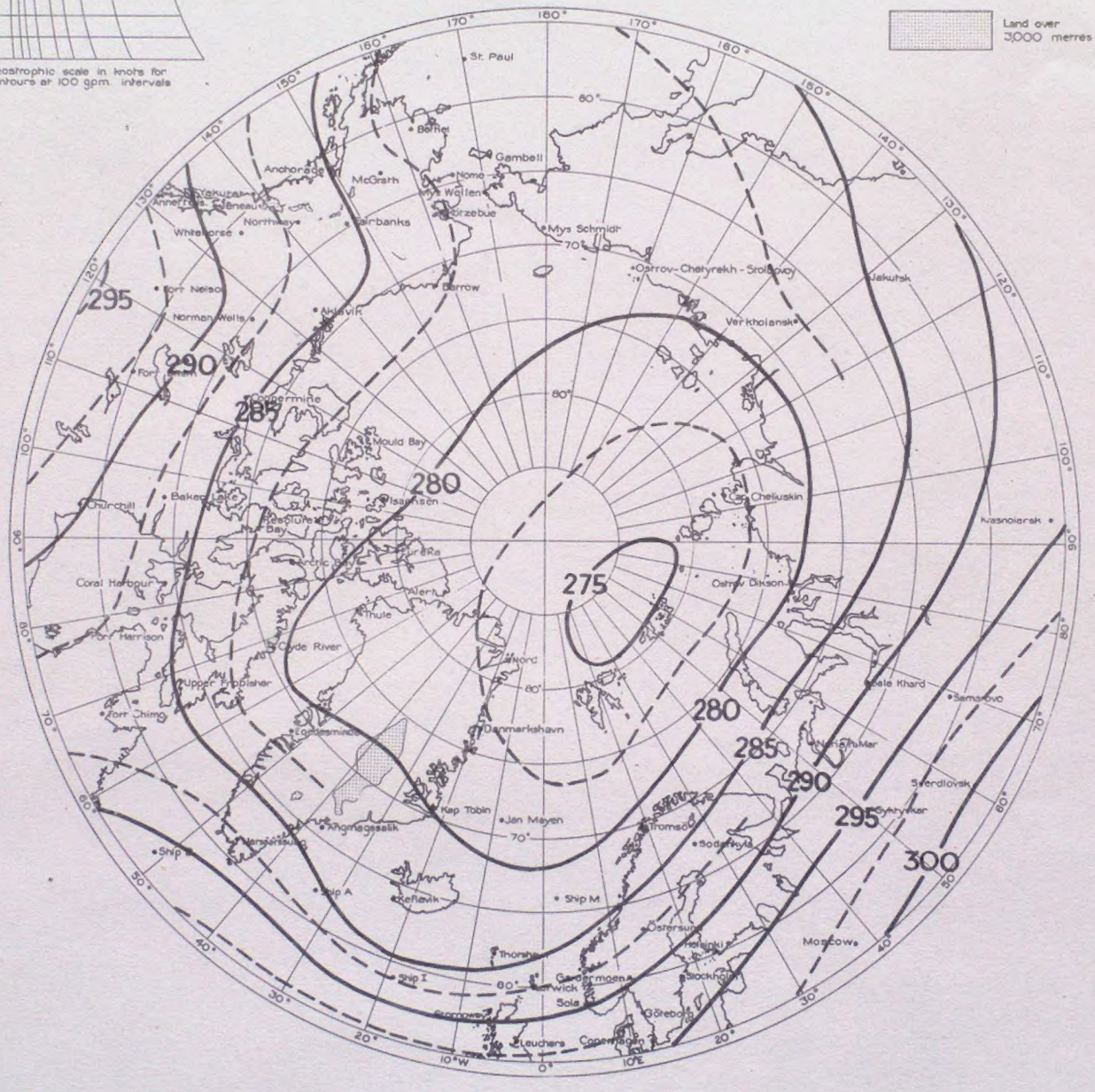




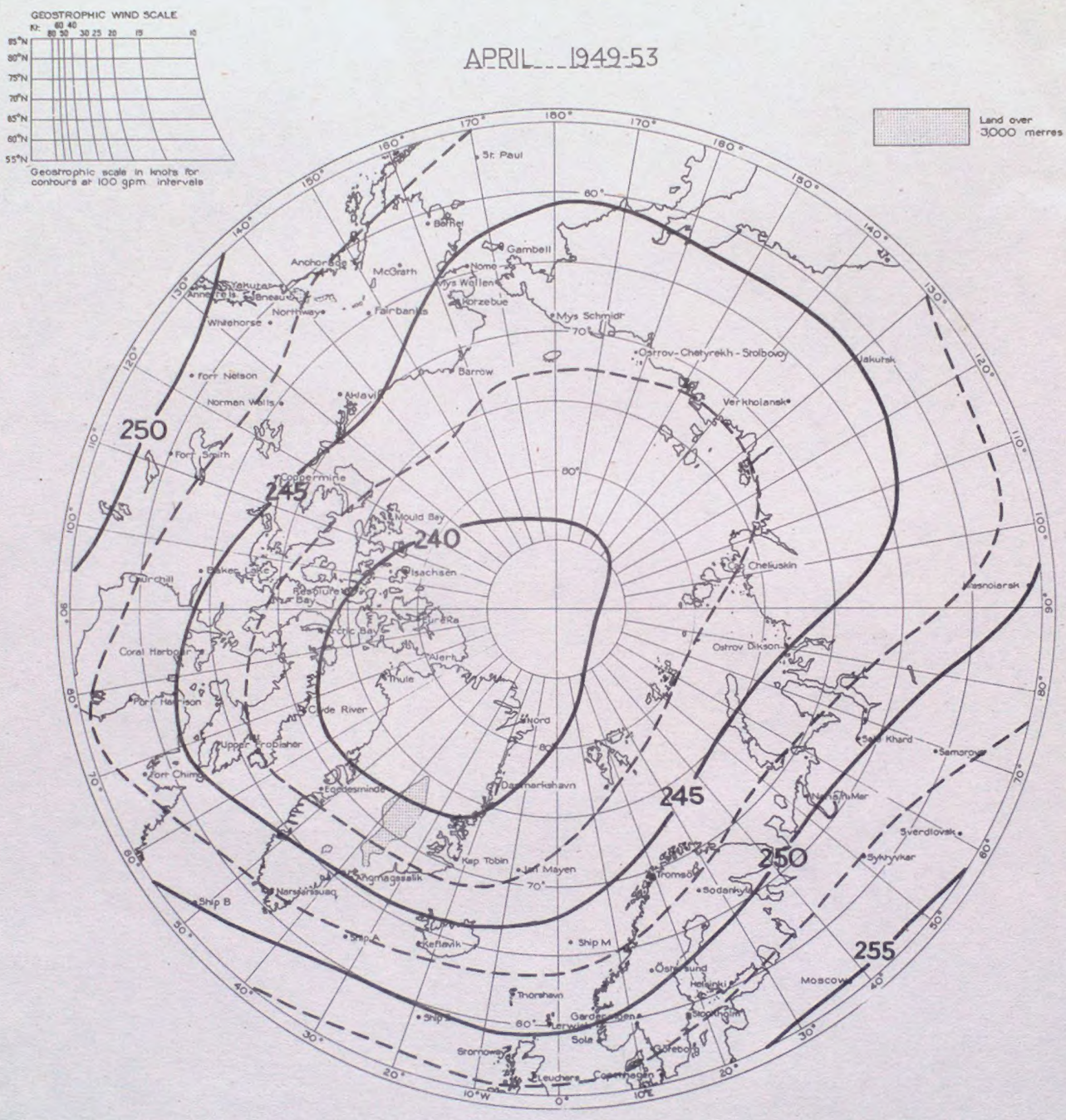
Height in dekametres

Upper Air Branch (M.O.23)

M.R.P. 1020

AVERAGE 700–500mb. THICKNESS

APRIL 1949-53



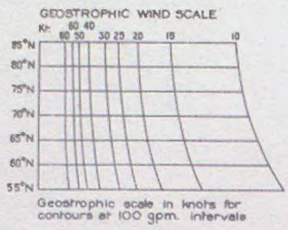
Height in dekametres

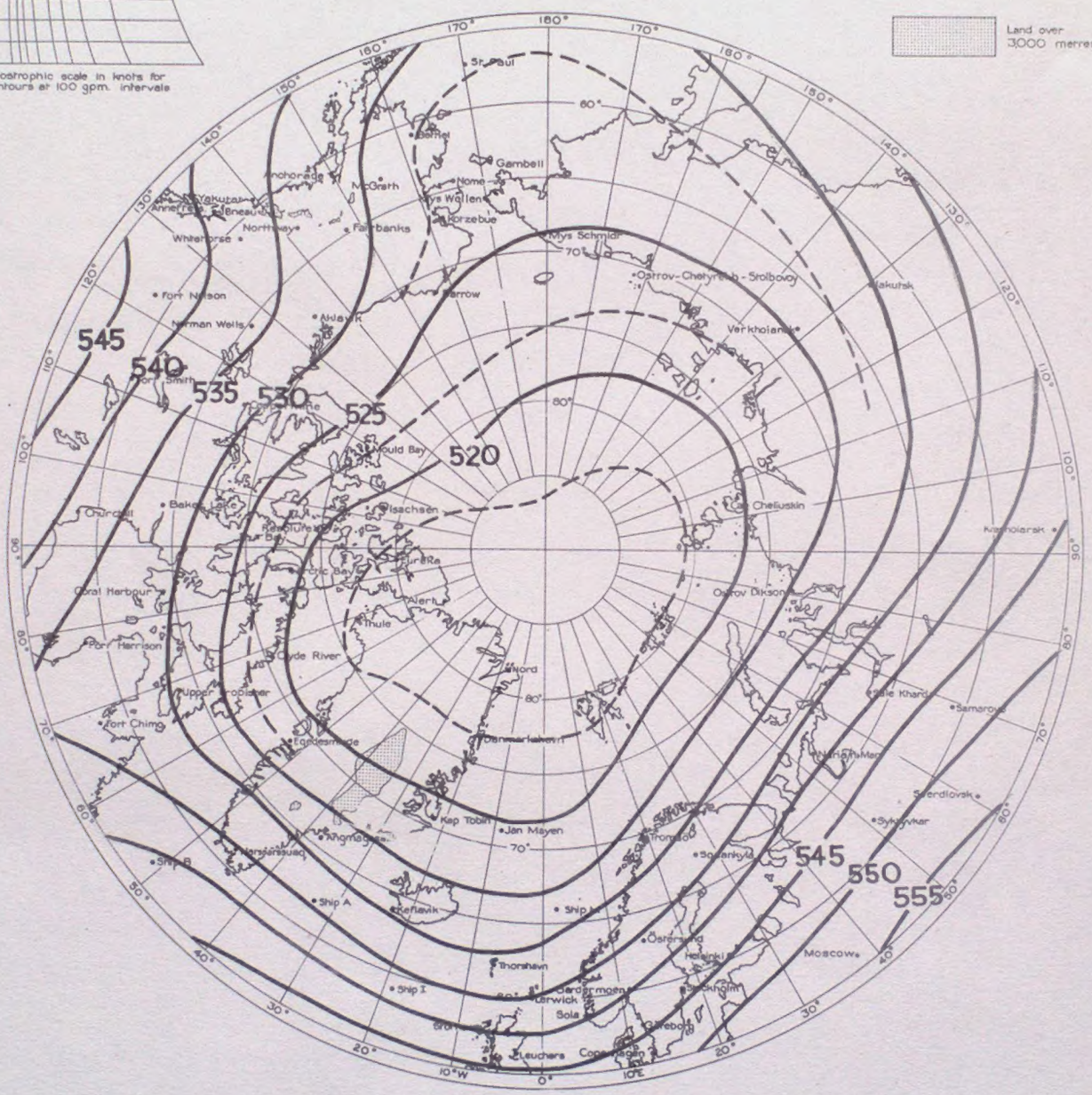
Upper Air Branch (M.O.23)

M.R.P. 1020

AVERAGE 500 mb. CONTOURS

APRIL 1949-53



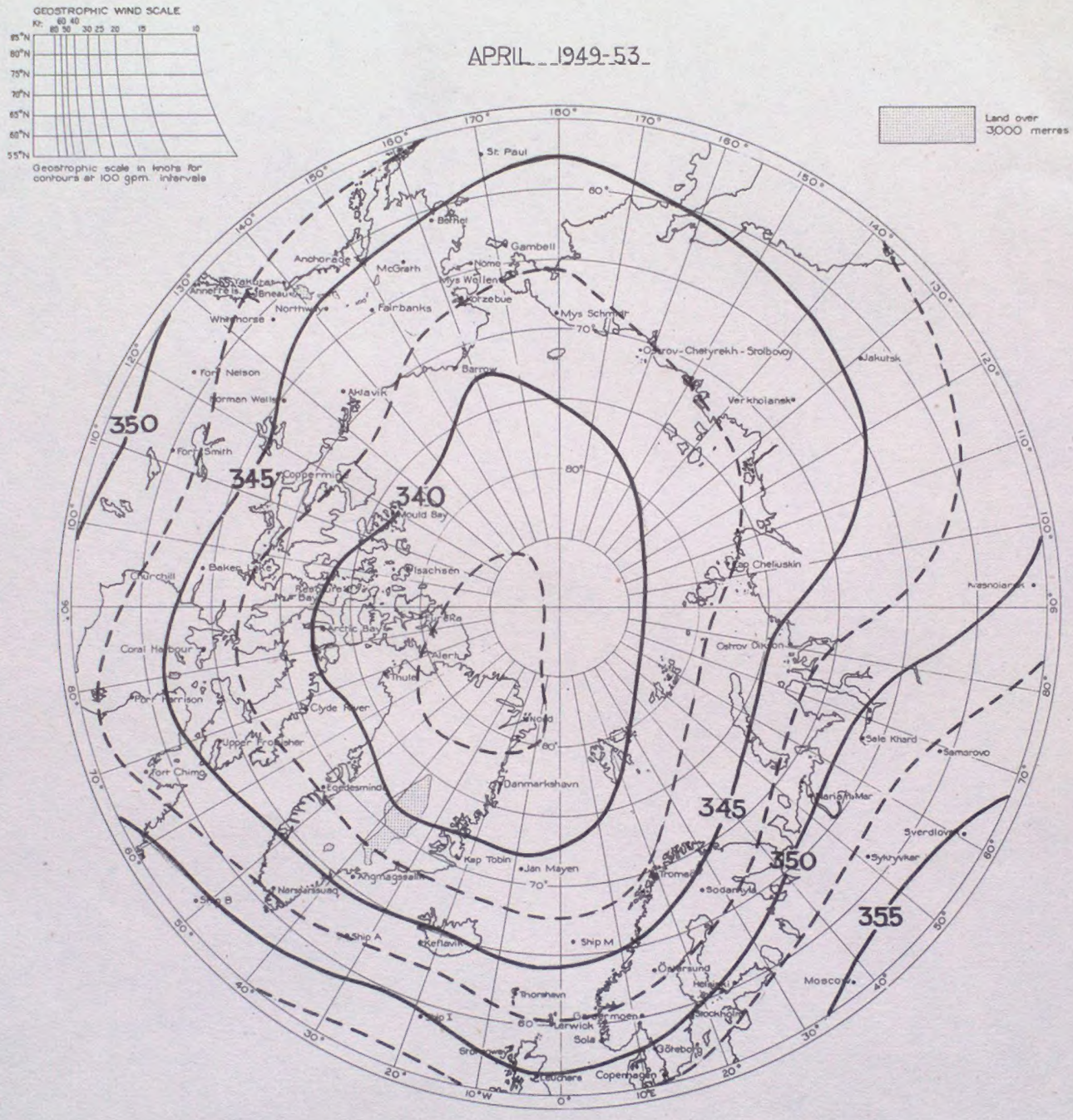


Height in dekametres

Upper Air Branch (M.O.23)

AVERAGE 500-300mb. THICKNESS

APRIL 1949-53



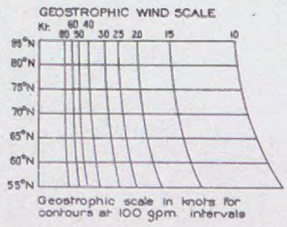
Height in dekametres

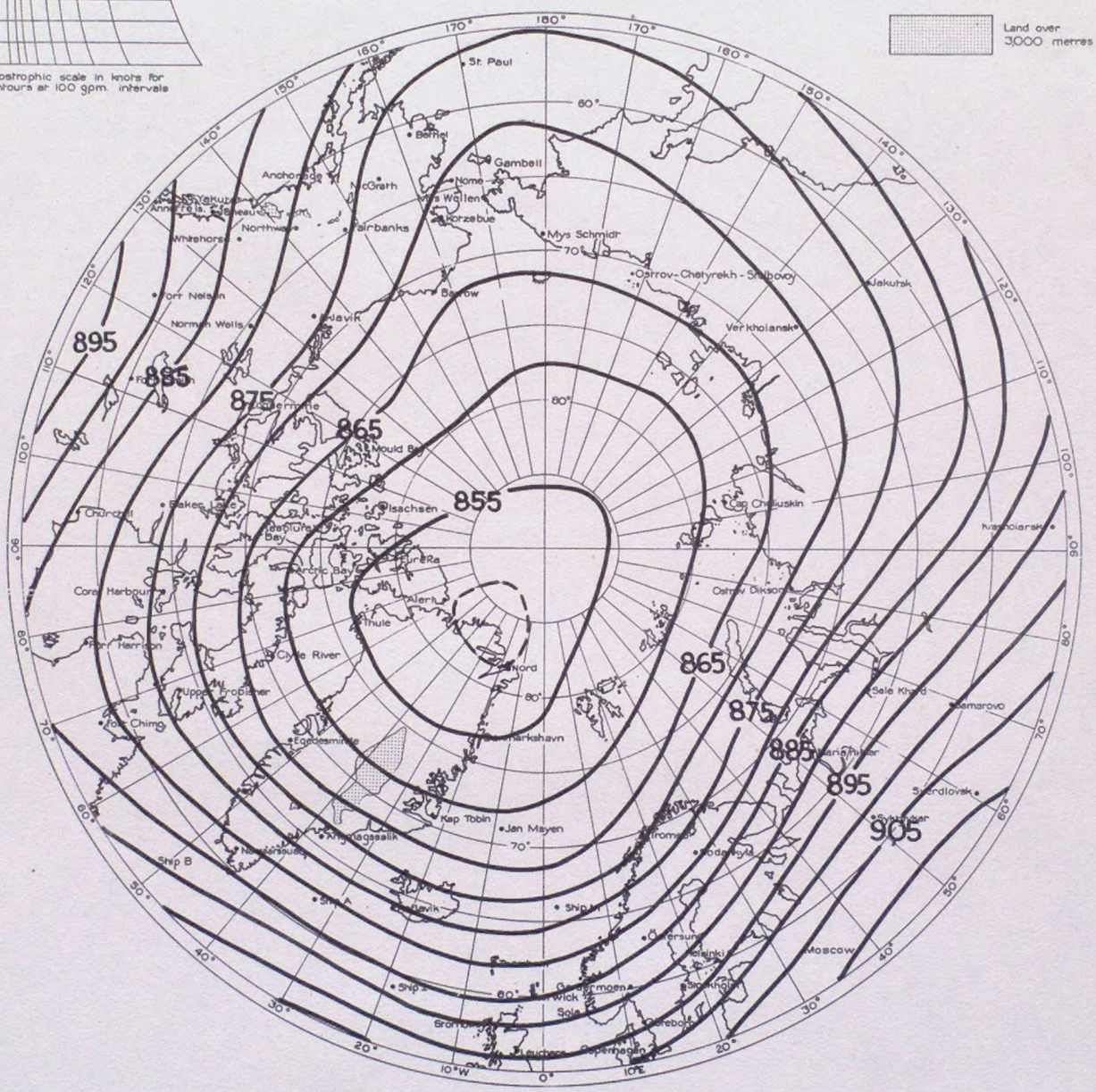
Upper Air Branch (M.O.23)

M.R.P. 1020

AVERAGE 300 mb. CONTOURS

APRIL 1949-53

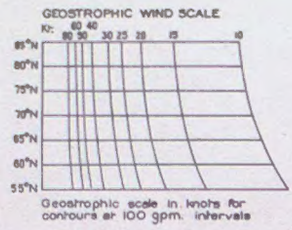


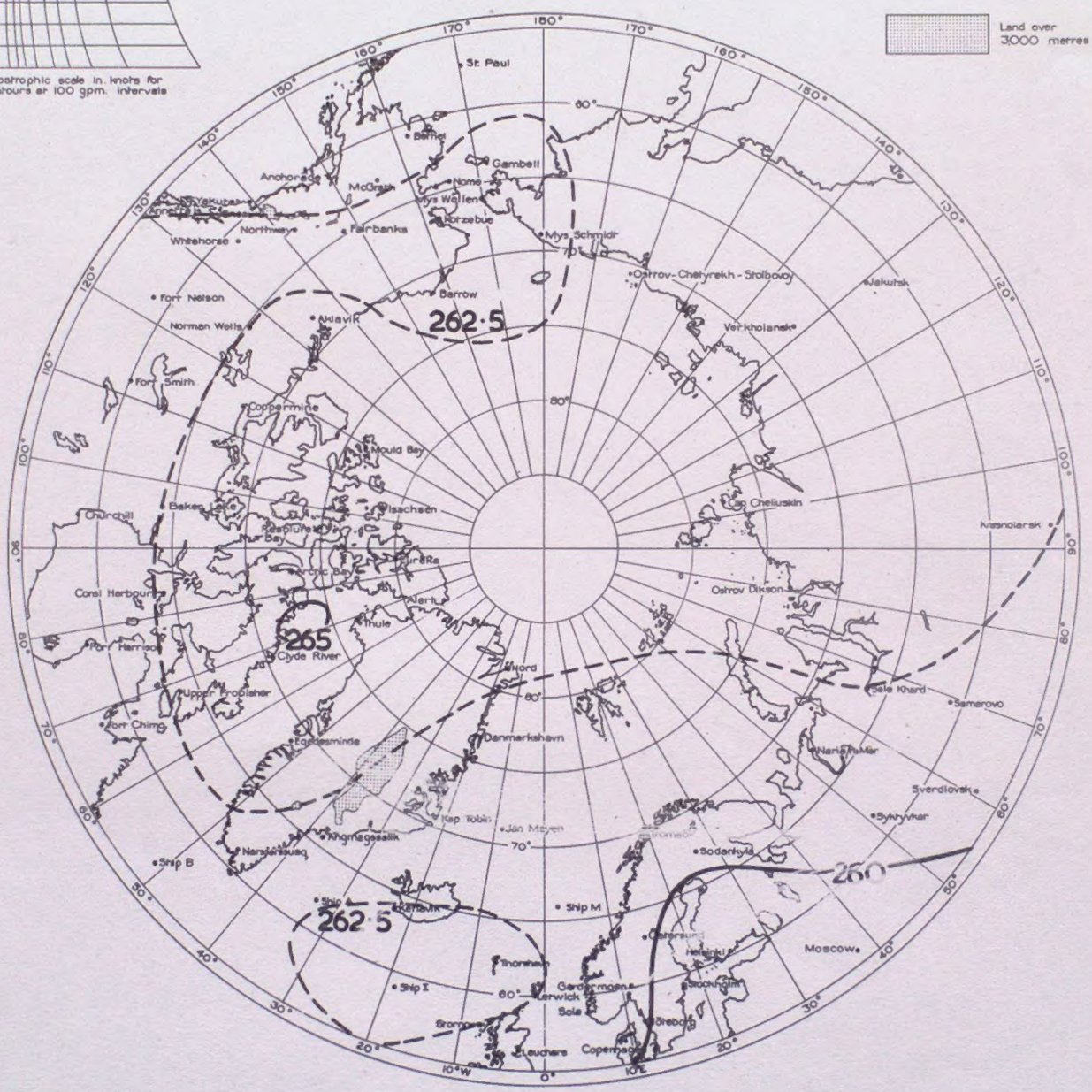

Land over 3,000 metres
895
885
875
865
855
865
875
885
895
905
St Paul
Barrow
Gambell
Nome
Kotzebue
Mys Schmidt
Ostrov-Chetyrekh-Stolbovoy
Jakutsk
Verkholansk
Fairbanks
Whitehorse
Fort Nelson
Norman Wells
Inuvik
Mould Bay
Resolute
Eureka
Alert
Thule
Nord
Churchill
Baker Lake
Coral Harbour
Clyde River
Arctic Bay
Pond Inlet
Ostrov Dikson
Sale Khard
Samarovo
Murmansk
Sverdlovsk
Moscow
Jan Mayen
Kap Tobin
Tromsö
Bodö
Ship B
Ship C
Ship I
Ship J
Wick
Sola
Stornoway
Reykjavik
Copenhagen
Godthaab
Egedesminde
Frobisher
Fort Chimo
Harrison
Anchorage
McGrath
Kotzebue
Aklavik
Barrow
Churchill
Baker Lake
Resolute
Eureka
Alert
Thule
Nord
Jan Mayen
Kap Tobin
Godthaab
Egedesminde
Frobisher
Fort Chimo
Harrison
Coral Harbour
Clyde River
Arctic Bay
Pond Inlet
Ostrov Dikson
Sale Khard
Samarovo
Murmansk
Sverdlovsk
Moscow
Tromsö
Bodö
Ship B
Ship C
Ship I
Ship J
Wick
Sola
Stornoway
Reykjavik
Copenhagen
Godthaab
Egedesminde
Frobisher
Fort Chimo
Harrison
Anchorage
McGrath
Kotzebue
Aklavik
Barrow
Inuvik
Mould Bay
Resolute
Eureka
Alert
Thule
Nord
Jan Mayen
Kap Tobin

M.R.P. 1020

AVERAGE 300-200mb. THICKNESS

APRIL 1949-53





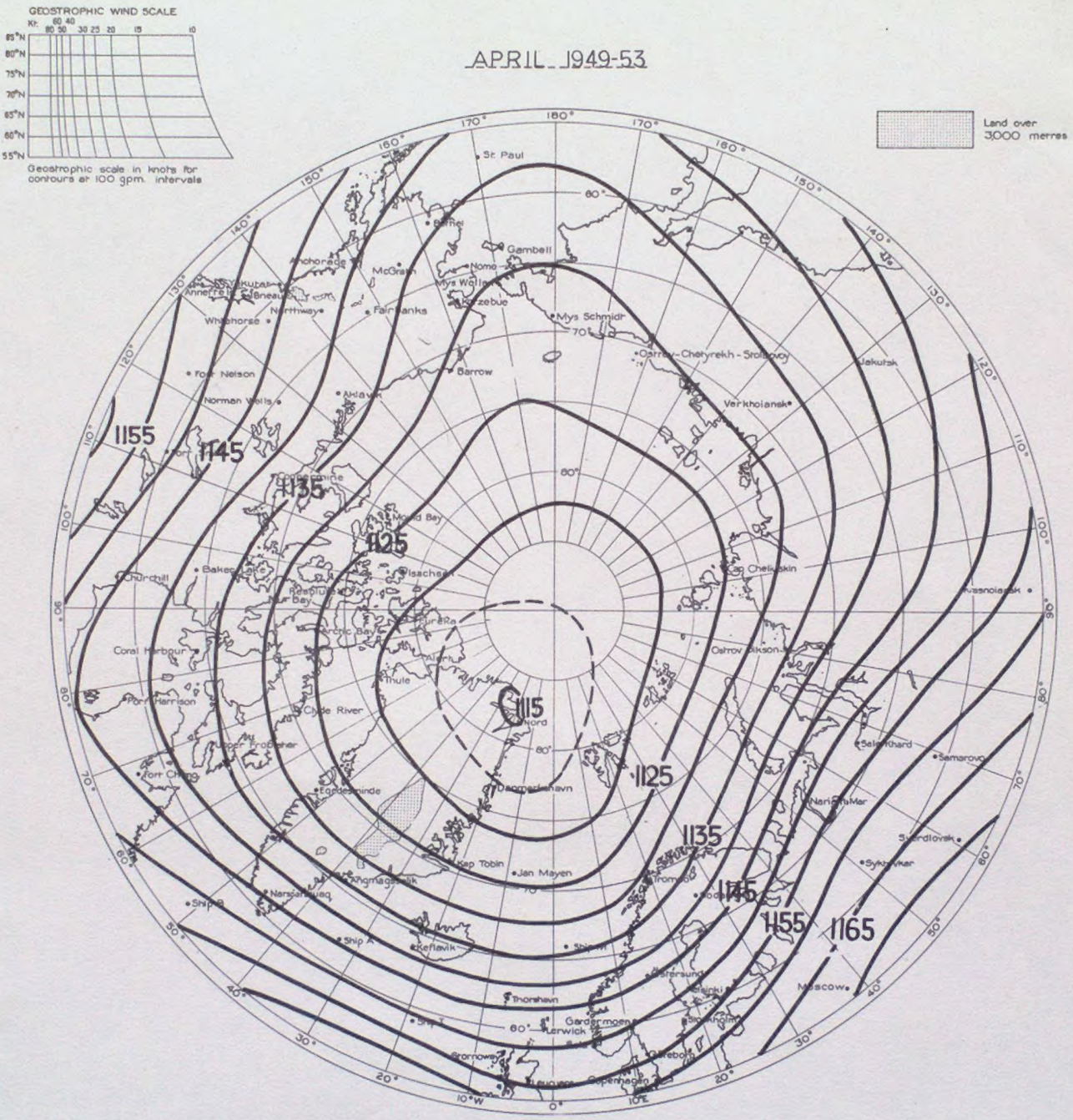
Height in dekametres

Upper Air Branch (M.O.23)

M.R.P. 1020

AVERAGE 200 mb. CONTOURS

APRIL 1949-53



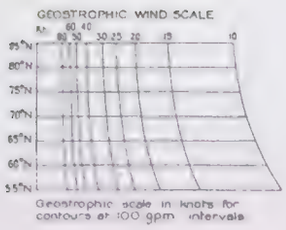
Height in dekametres

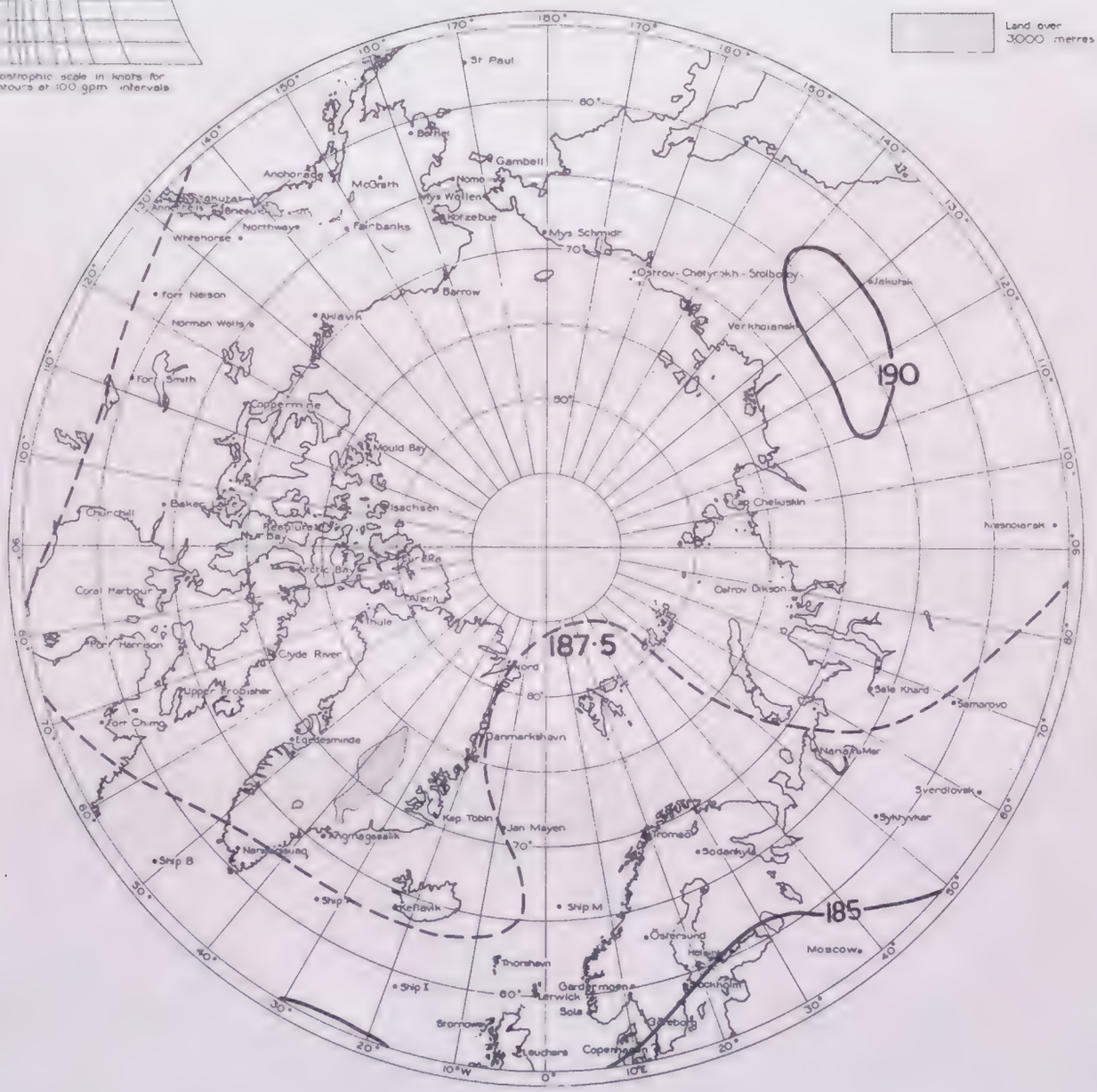
Upper Air Branch (M.O.23)

M.R.P. 1020

AVERAGE 200-150mb. THICKNESS

APRIL 1949-53





Height in dekametres

Upper Air Branch (M.O.23)

AVERAGE 150 mb CONTOURS

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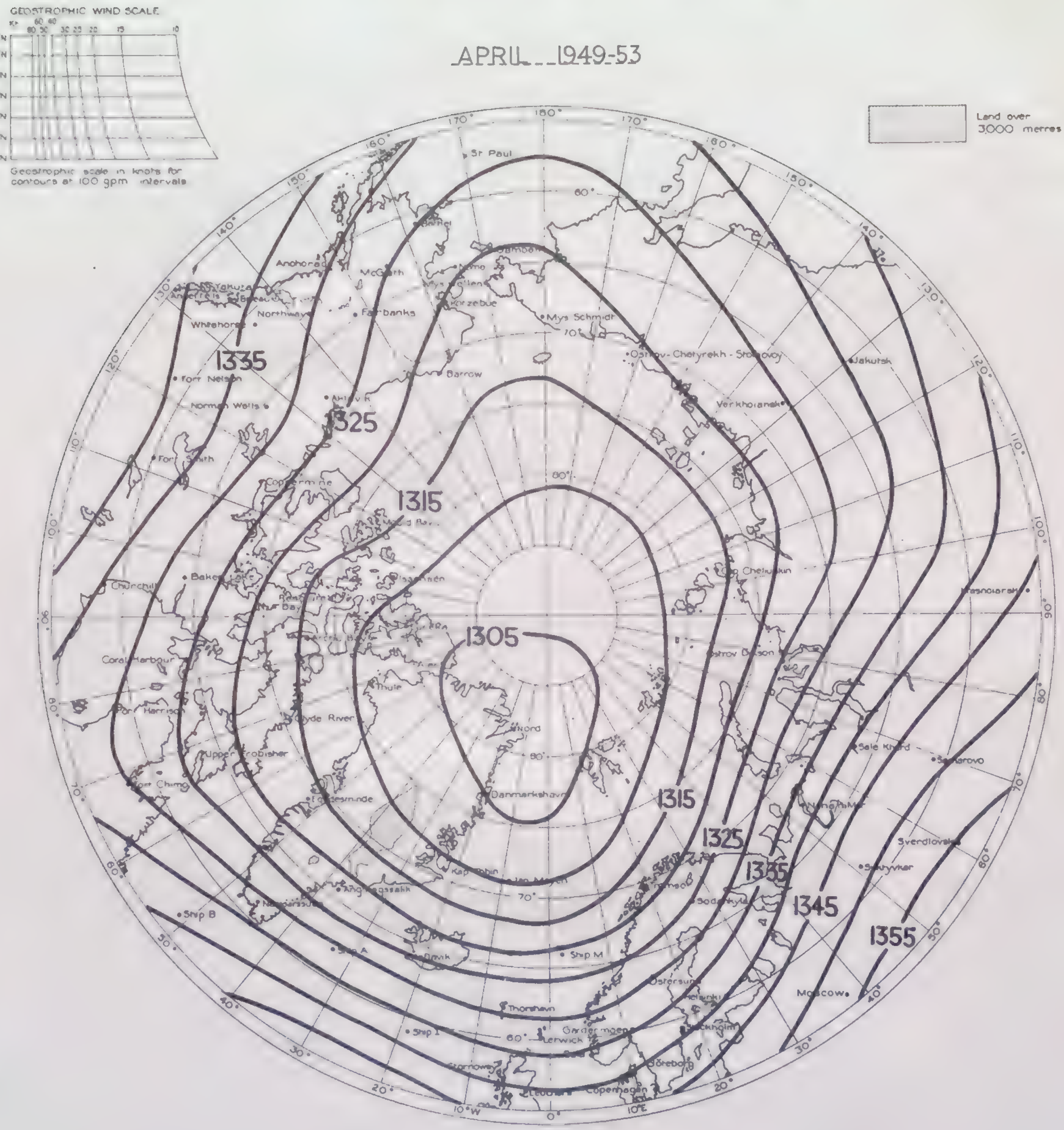


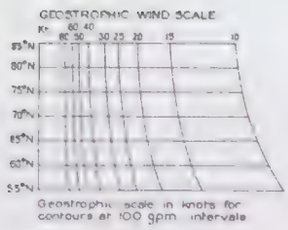
Height in dekametres

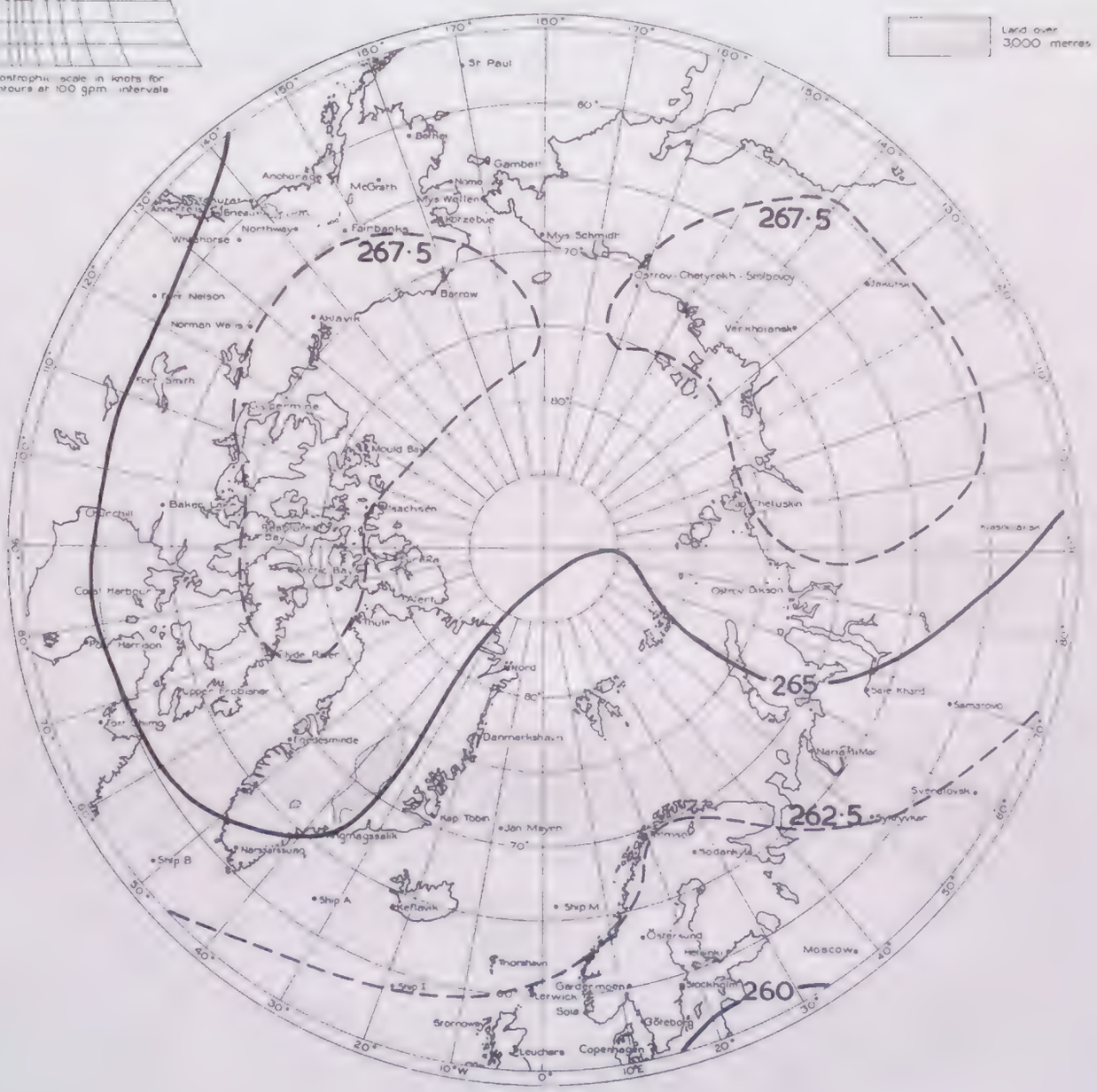
Upper Air Branch (M.O.23)

M.R.P. 1020

AVERAGE 1500-1000mb. THICKNESS

APRIL 1949-53





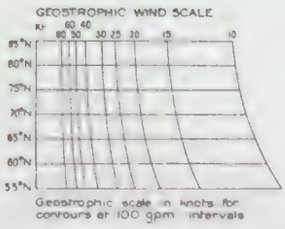
Height in dekametres

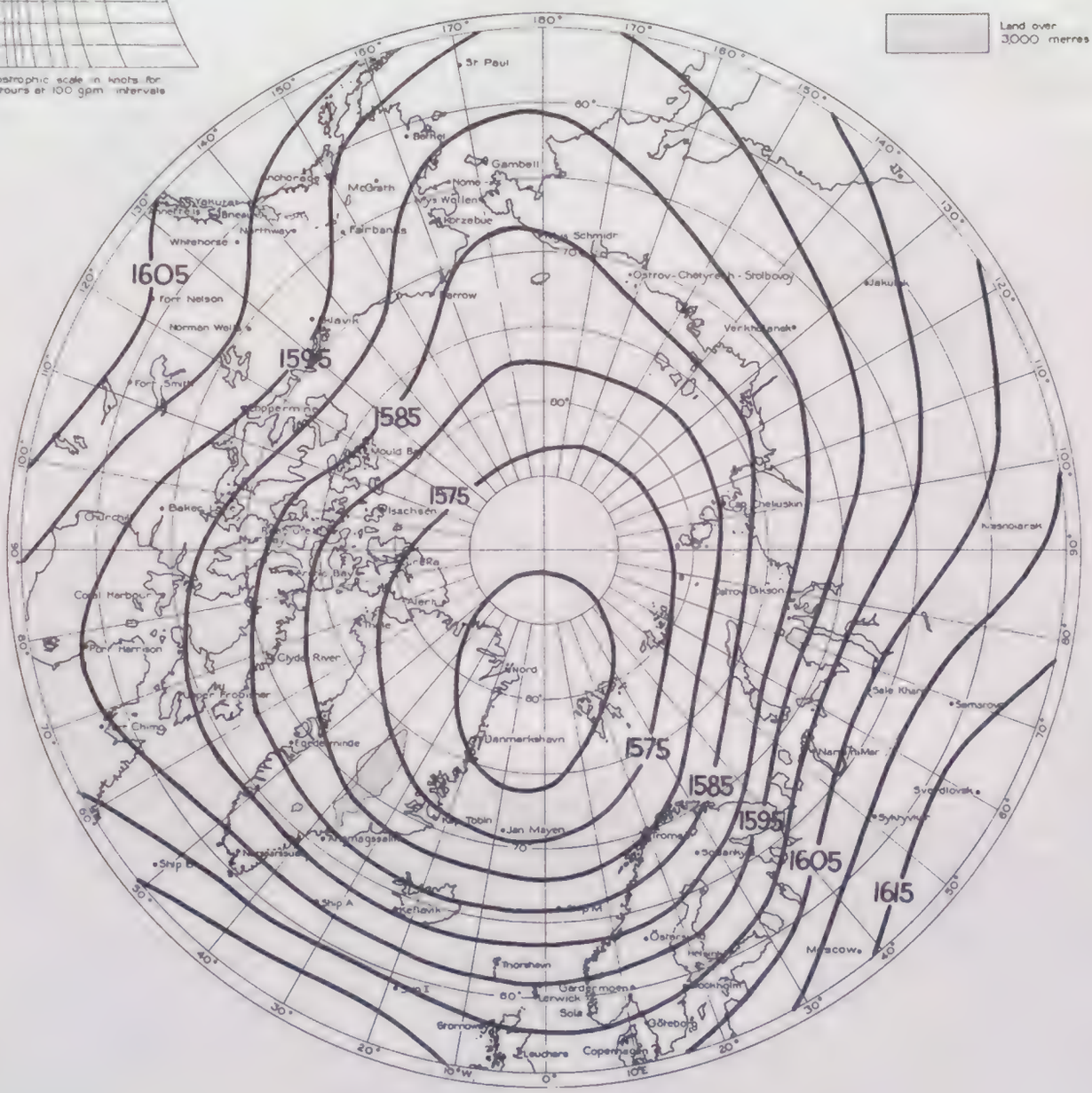
Upper Air Branch (M.O.23)

M.R.P. 1020

AVERAGE 100 mb CONTOURS

APRIL 1949-53



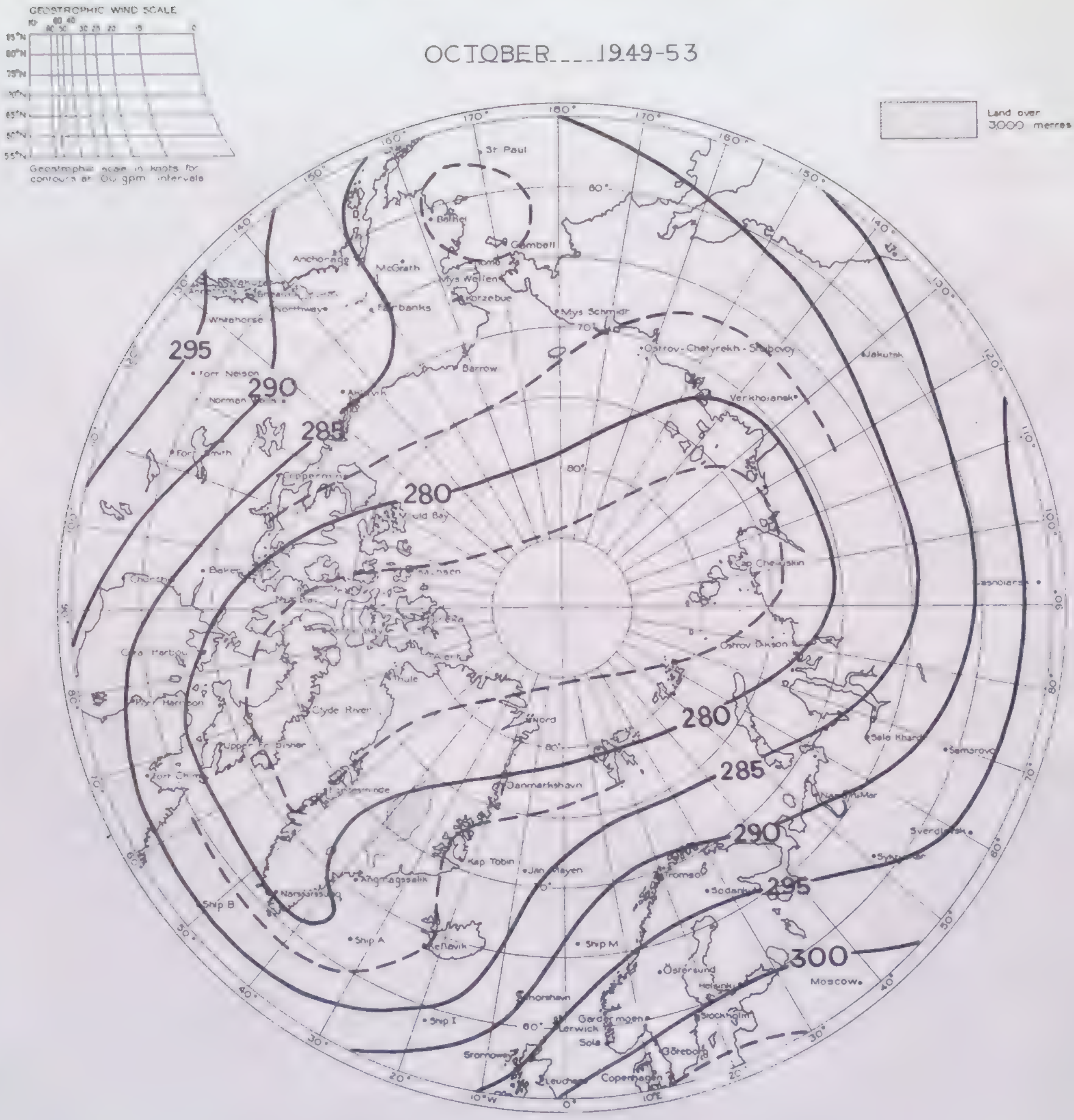


Height in dekametres

Upper Air Branch (M.O.23)

AVERAGE 700 mb. CONTOURS

OCTOBER 1949-53



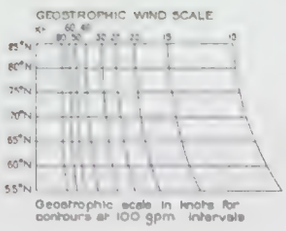
Height in dekametres

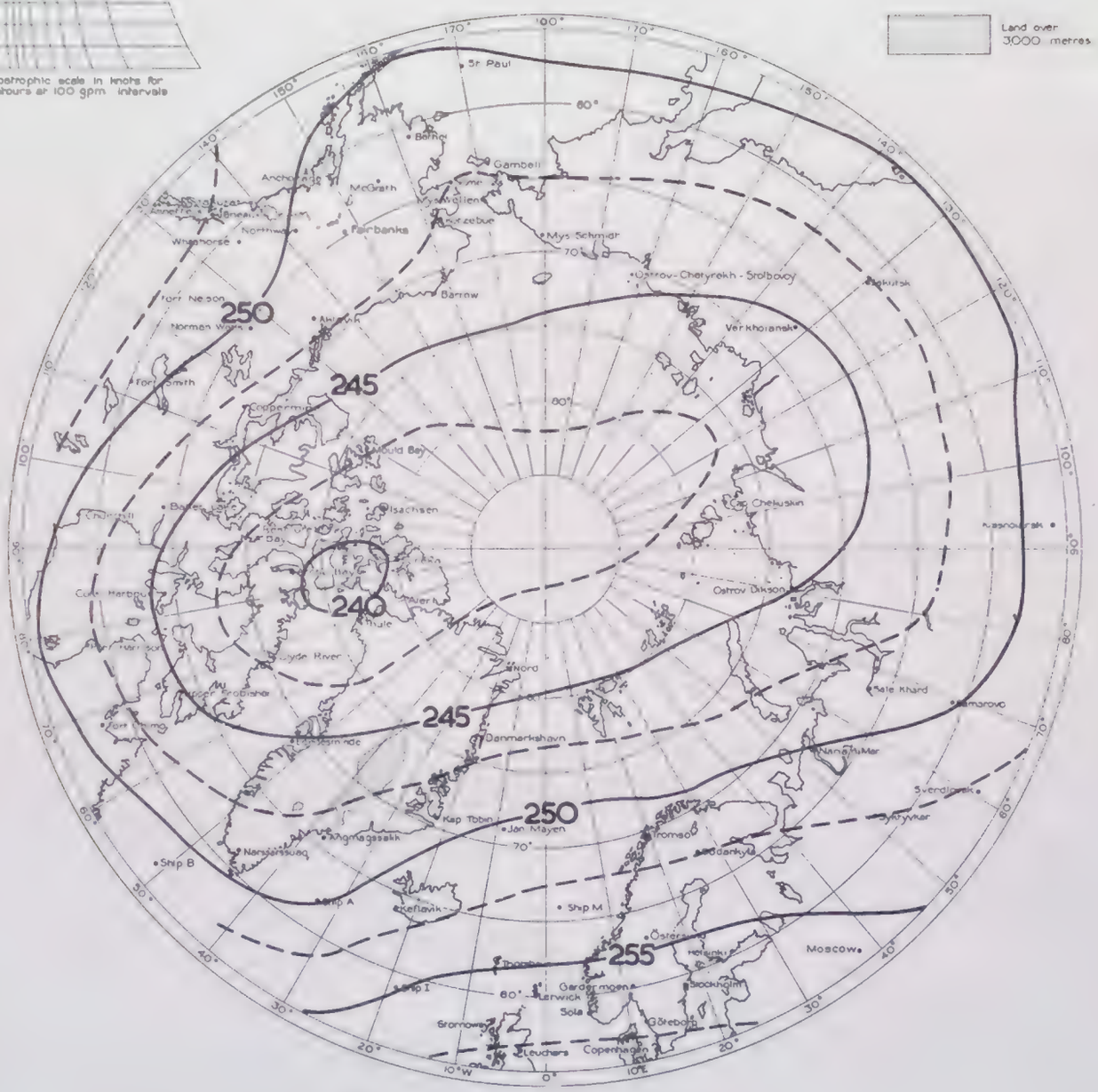
Upper Air Branch (M.O.23)

M.R.P. 1020

700-500 mb THICKNESS

OCTOBER 1949-53





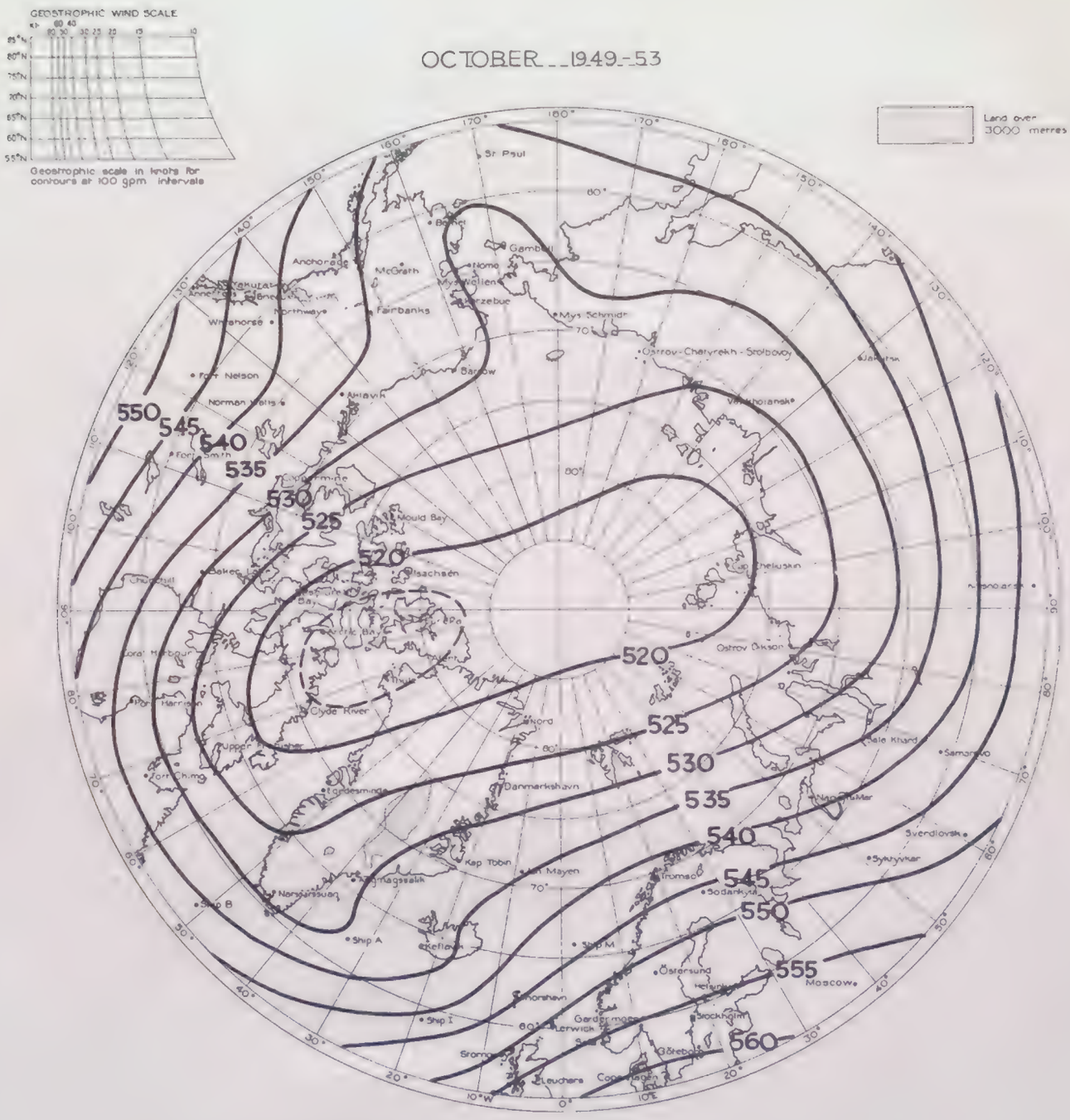
Height in dekametres

Upper Air Branch (M.O.23)

M.R.P. 1020

AVERAGE 500 mb CONTOURS

OCTOBER 1949-53



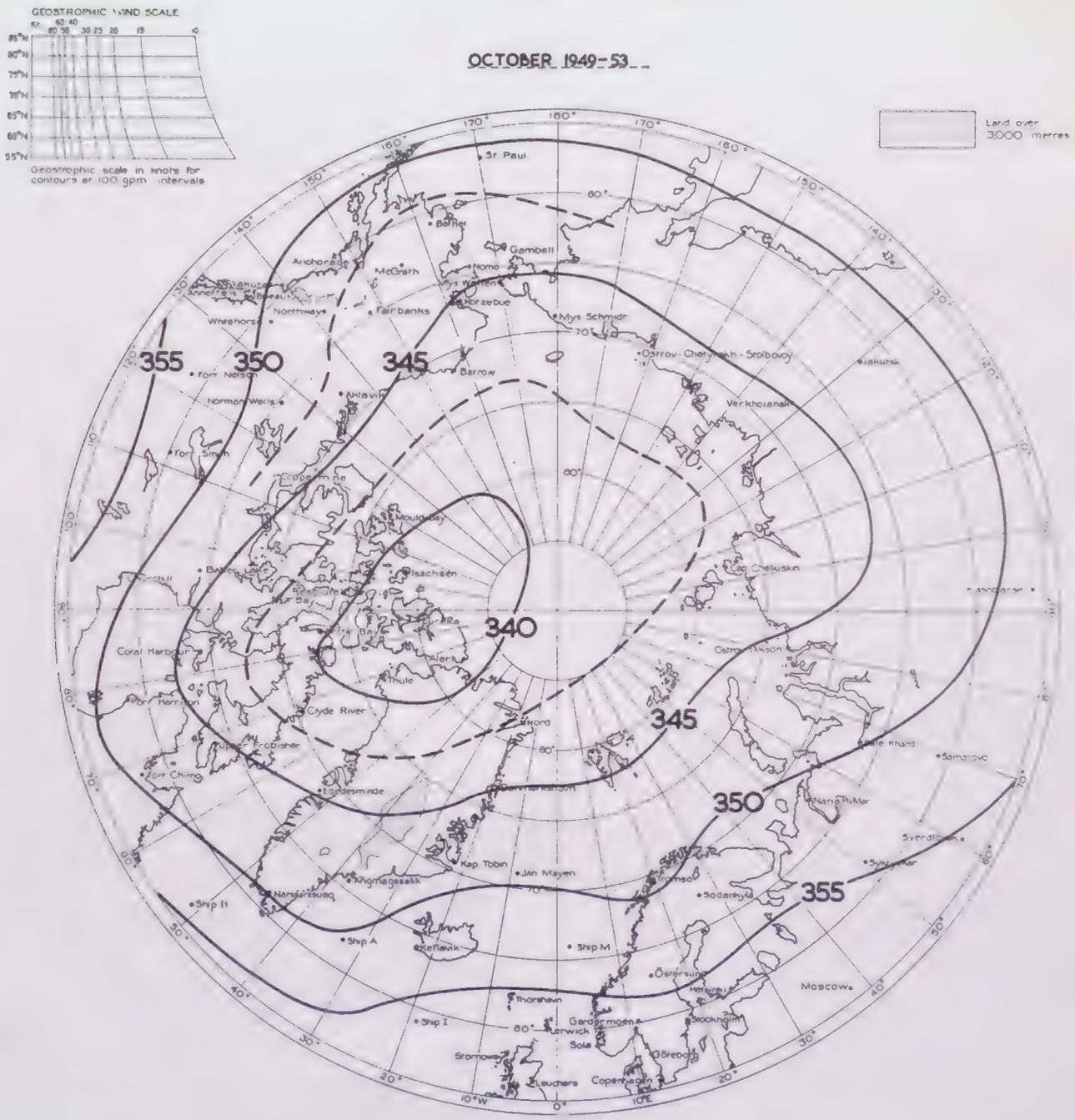
Height in dekametres

Upper Air Branch (M.O.23)

M.R.P. 1020

500-300 mb. THICKNESS

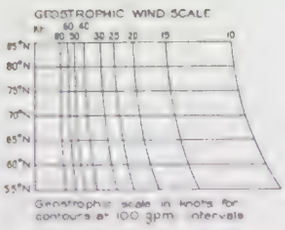
OCTOBER 1949-53

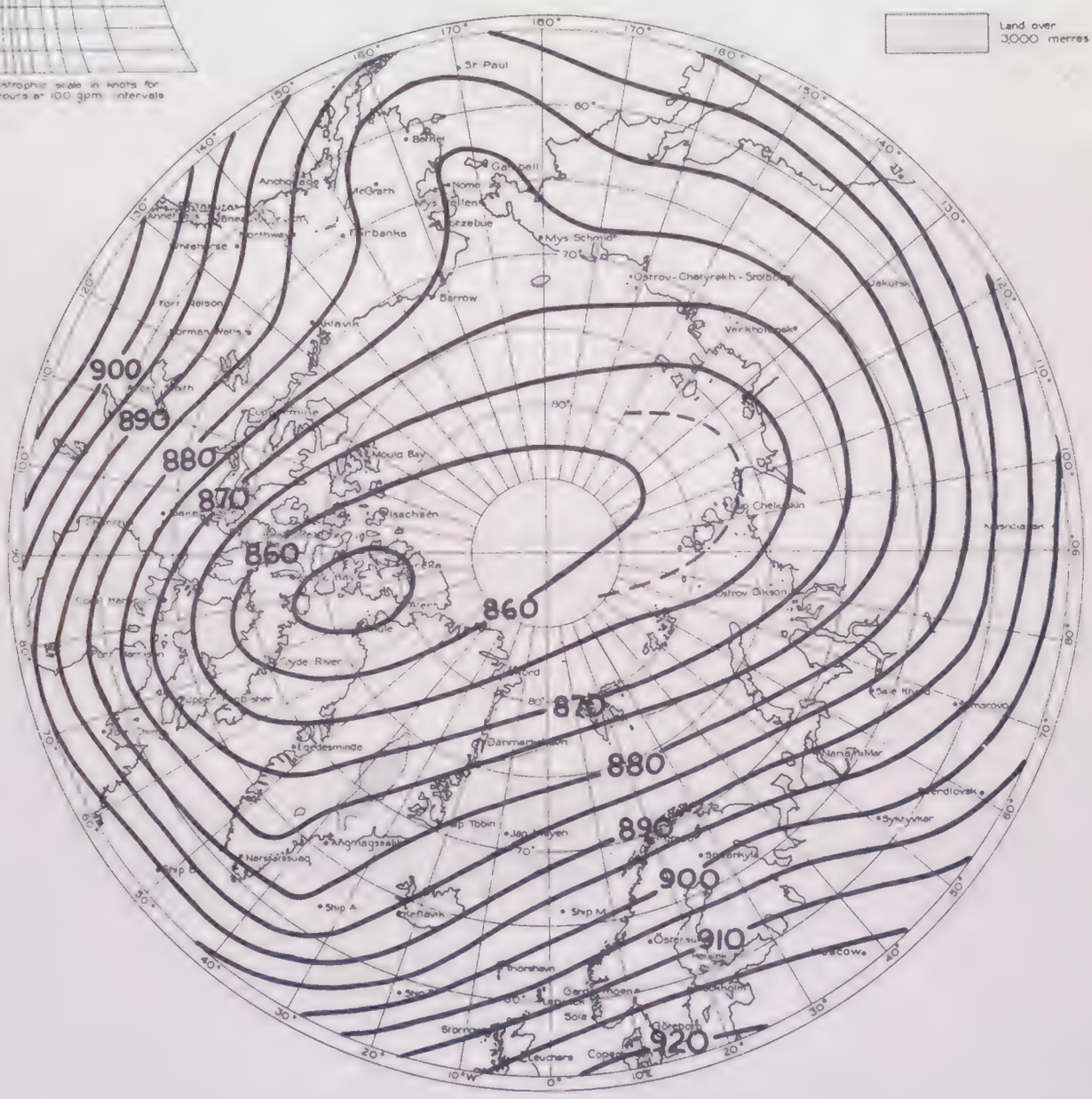


M.R.P.1020

AVERAGE ___300_mb. CONTOURS

OCTOBER 1949 – 53



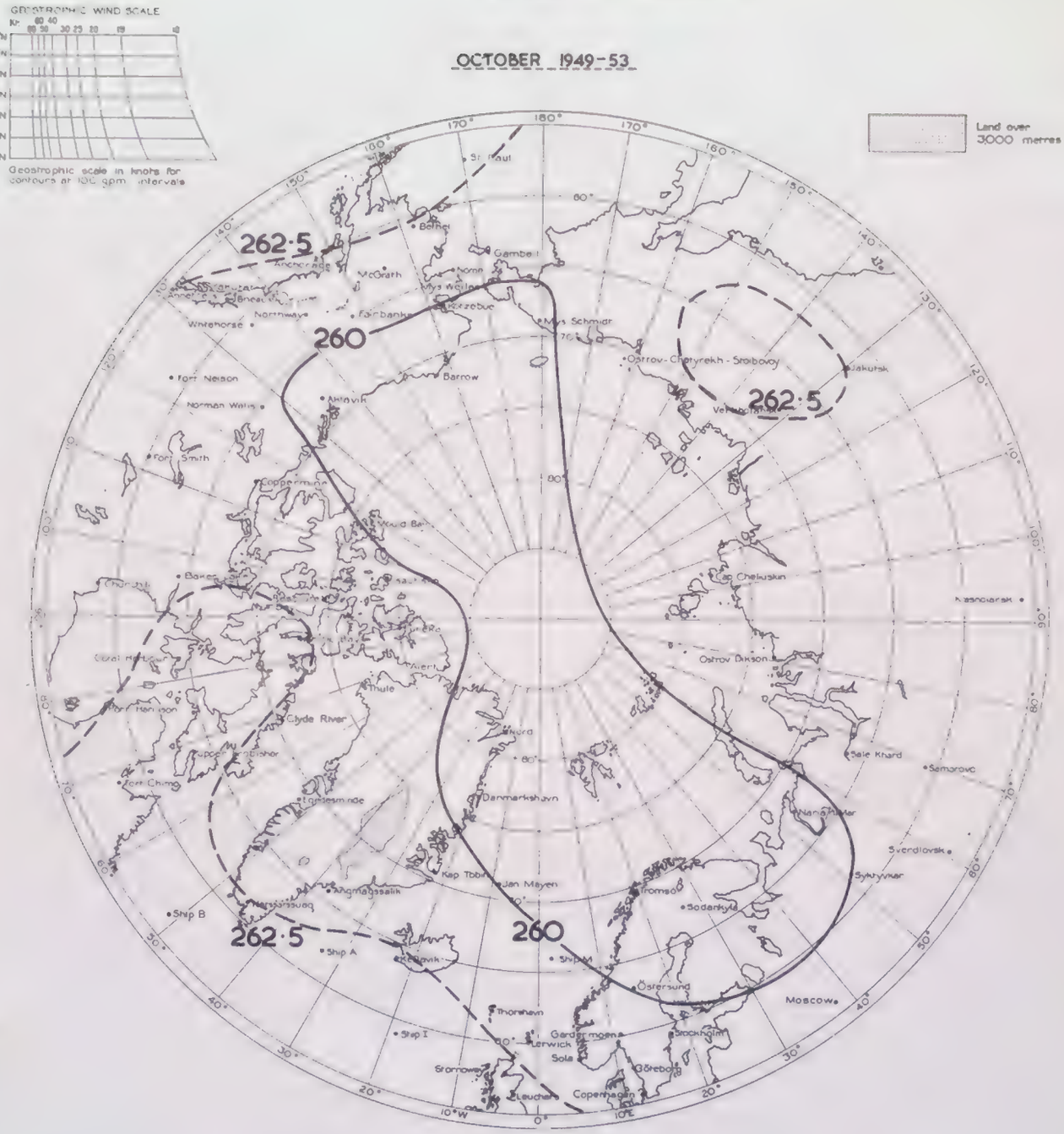


Height in dekametres

Upper Air Branch (M.O.23)

300-200 mb THICKNESS

OCTOBER 1949-53

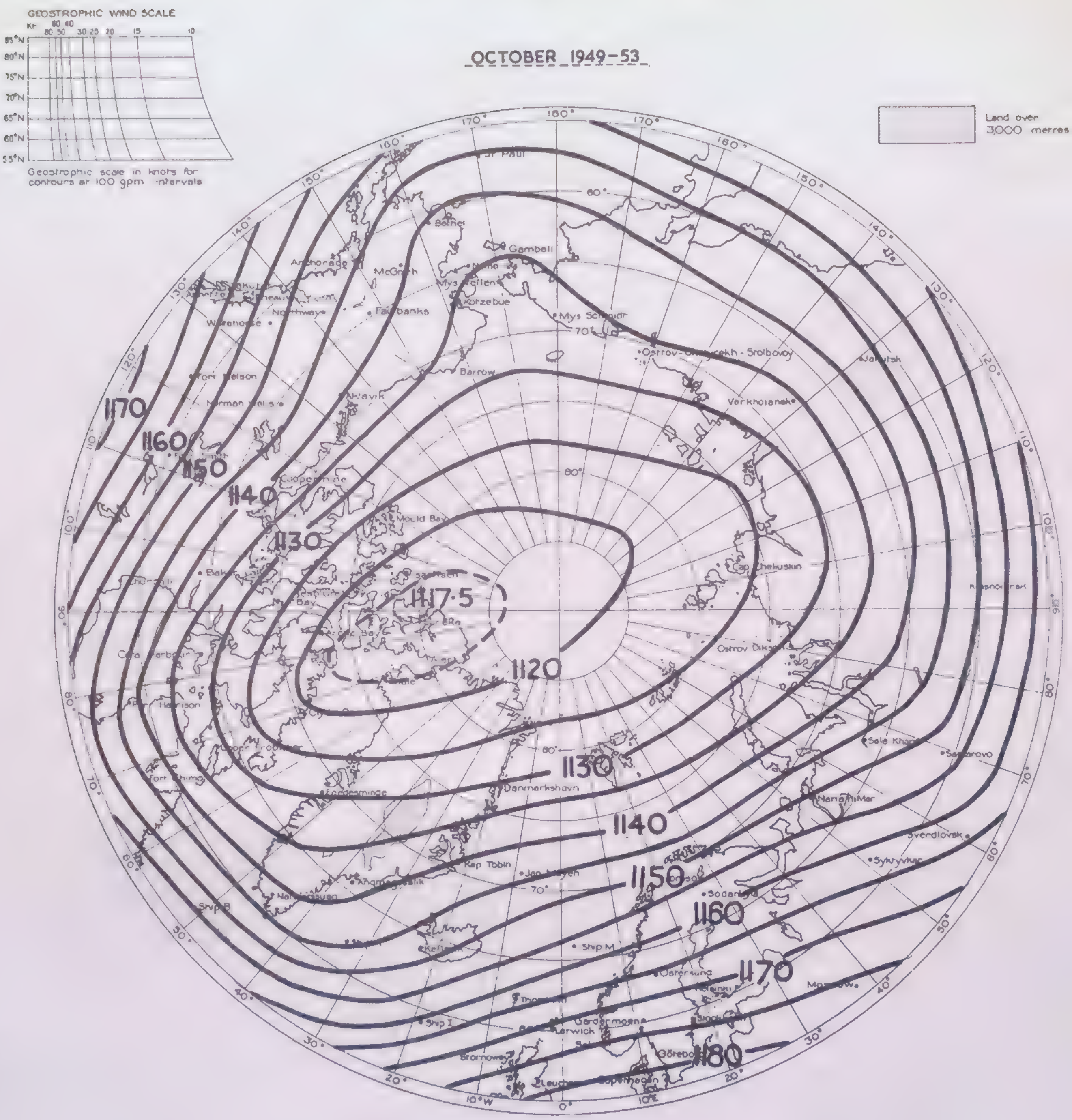


Height in dekametres

Upper Air Branch (M.O.23)

AVERAGE 200 mb. CONTOURS

OCTOBER 1949-53

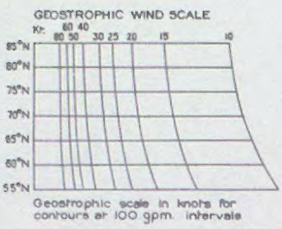


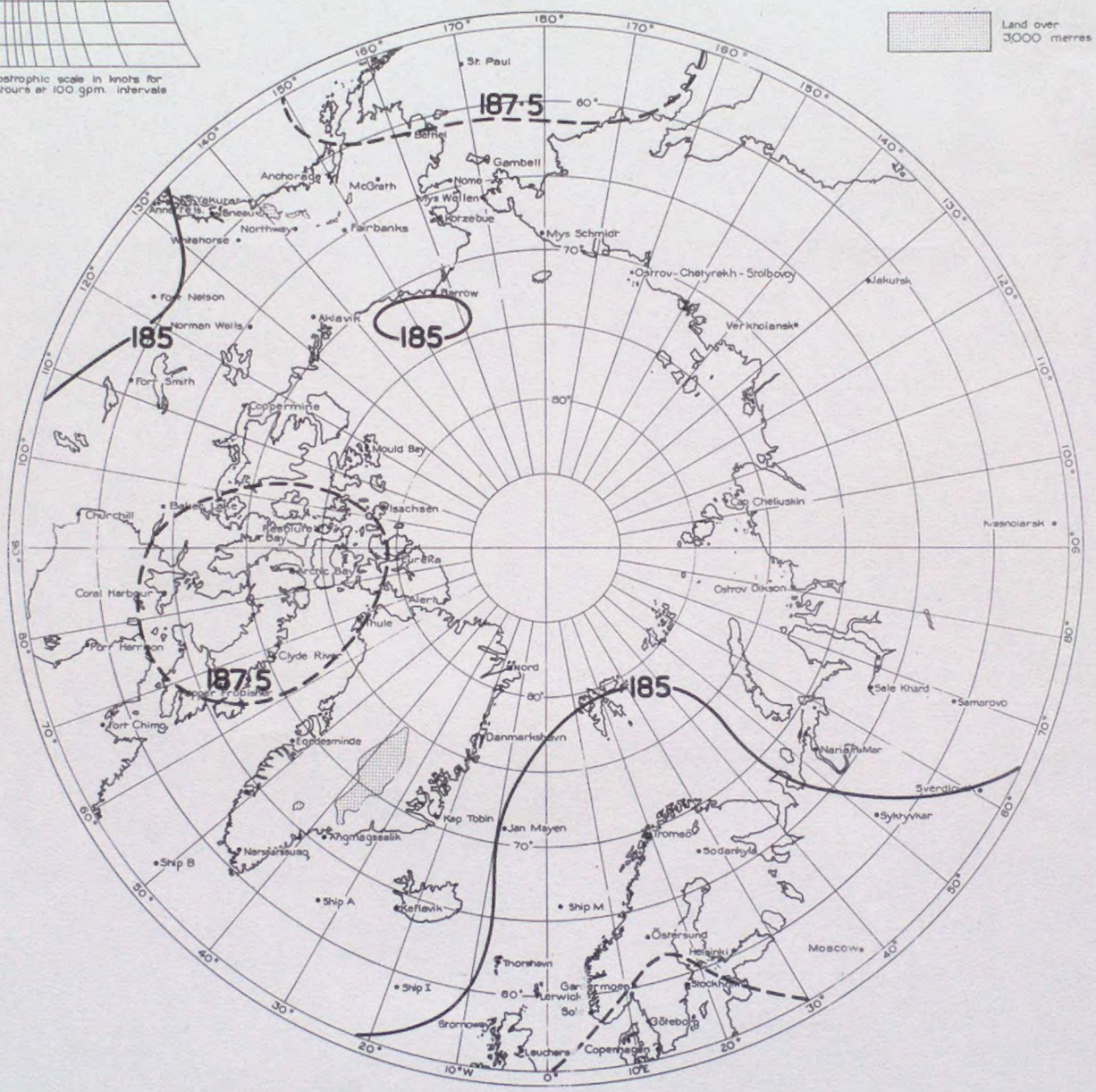
Height in dekametres

Upper Air Branch (M.O.23)

200-150 mb. THICKNESS

OCTOBER 1949-53



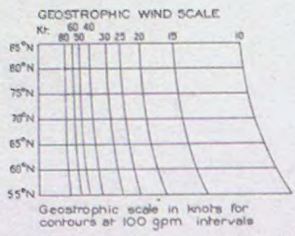


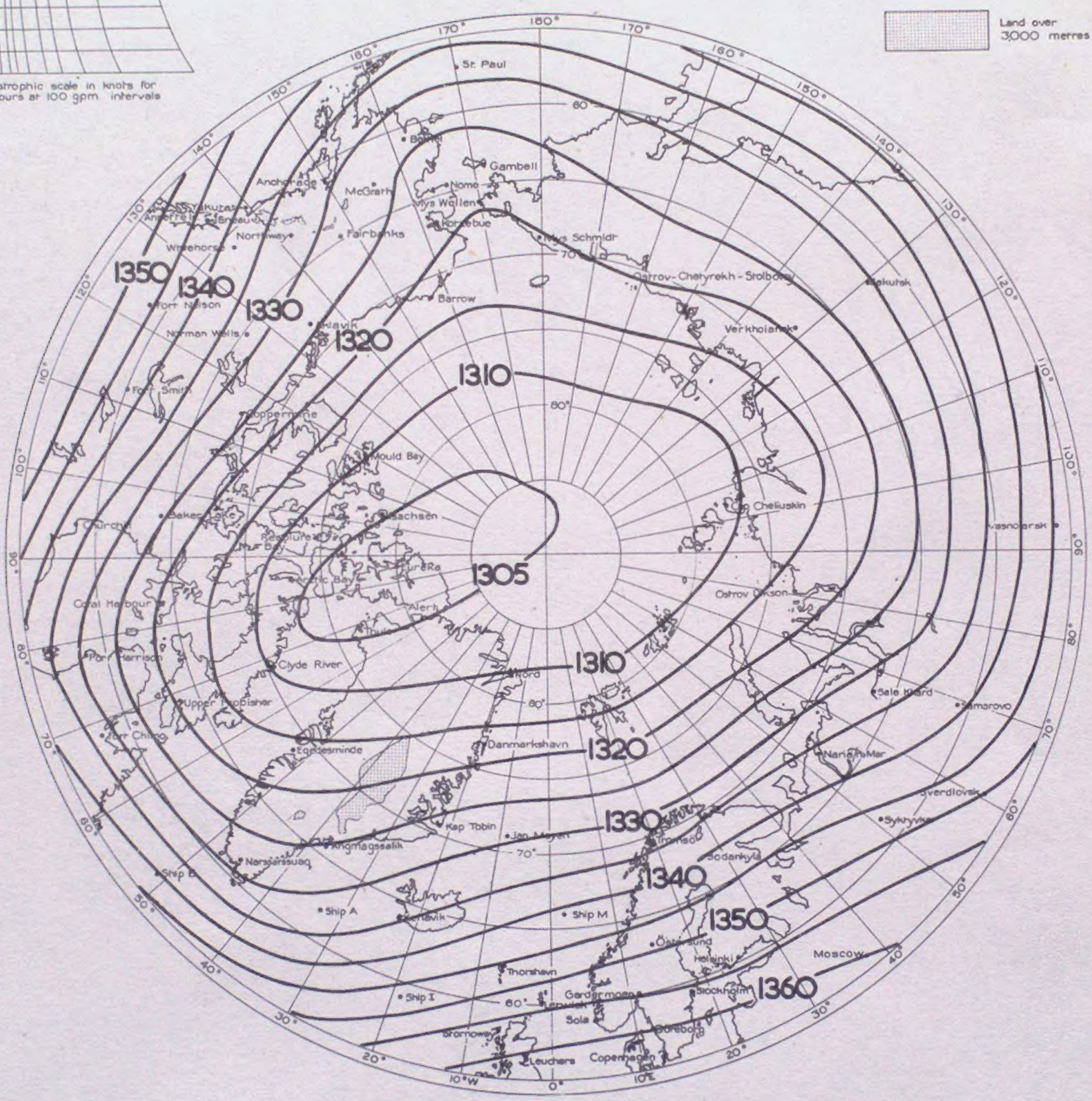
Height in dekametres

Upper Air Branch (M.O.23)

AVERAGE 150 mb. CONTOURS

OCTOBER 1949-53





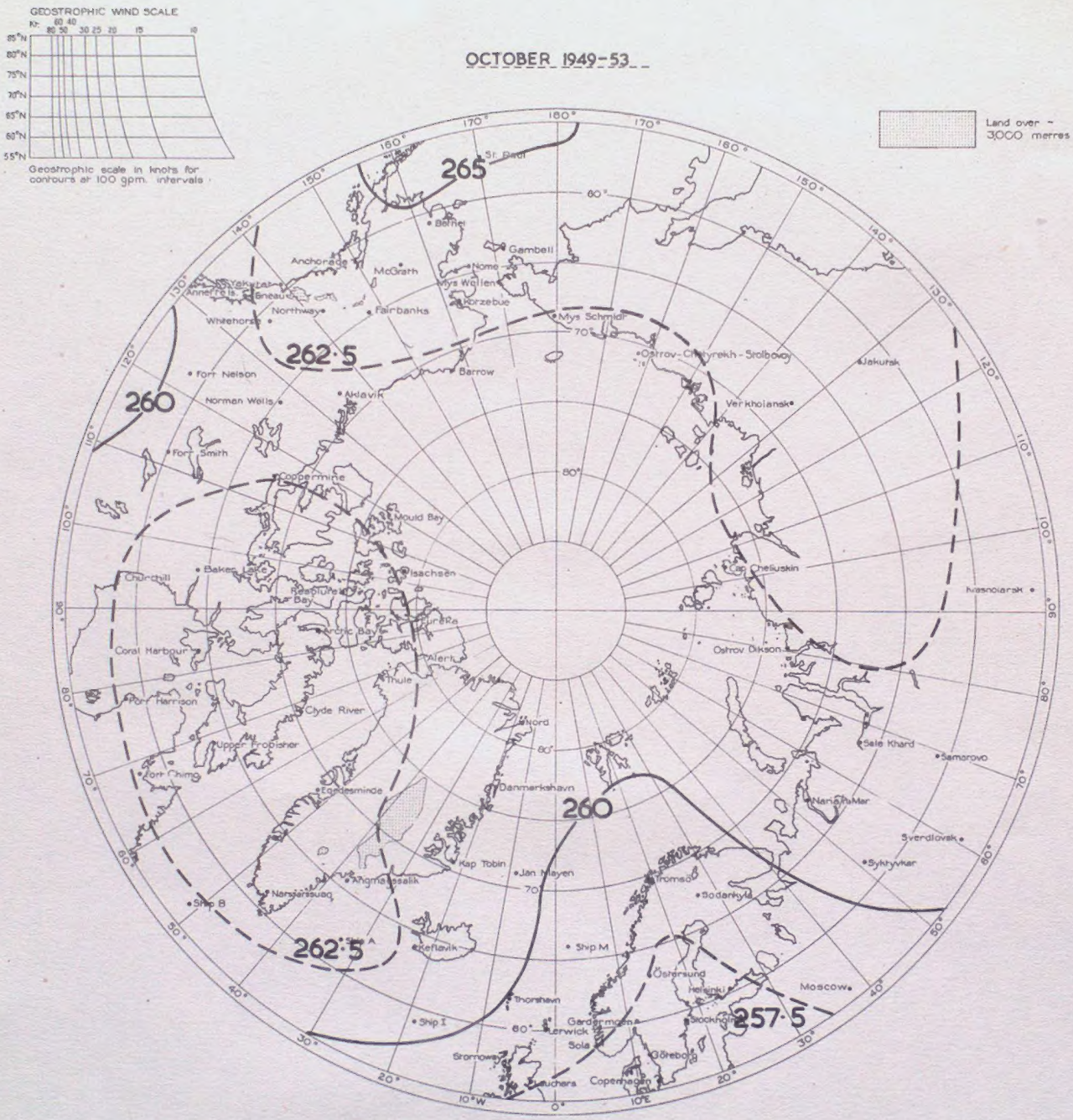
Height in dekametres

Upper Air Branch (M.O.23)

M.R.P. 1020

150 - 100 mb. THICKNESS

OCTOBER 1949-53

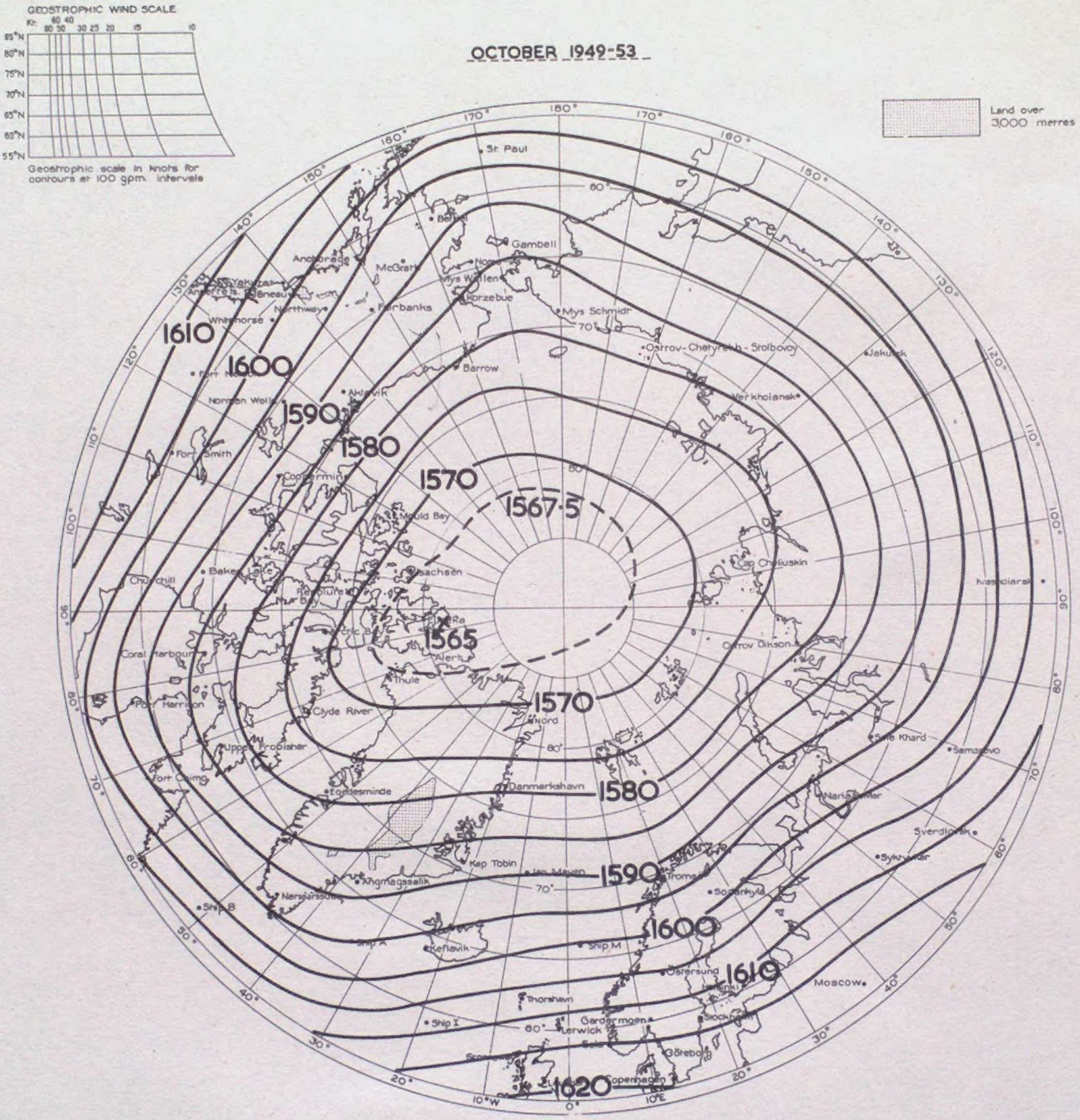


Height in dekametres

Upper Air Branch (M.O23)

AVERAGE 100 mb. CONTOURS

OCTOBER 1949-53



Height in dekametres

Upper Air Branch (M.O.23)